Simulation-Based Design

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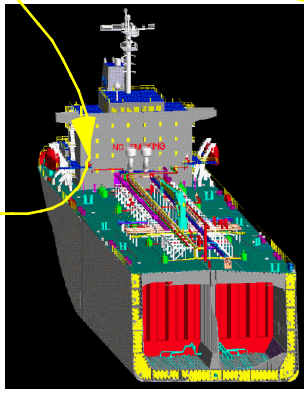
Simulation-Based Design

Multi-Disciplinary Optimization At Any Stage of Product's Life Cycle

Multiple Virtual Products Operating in Physics Based Synthetic Environments

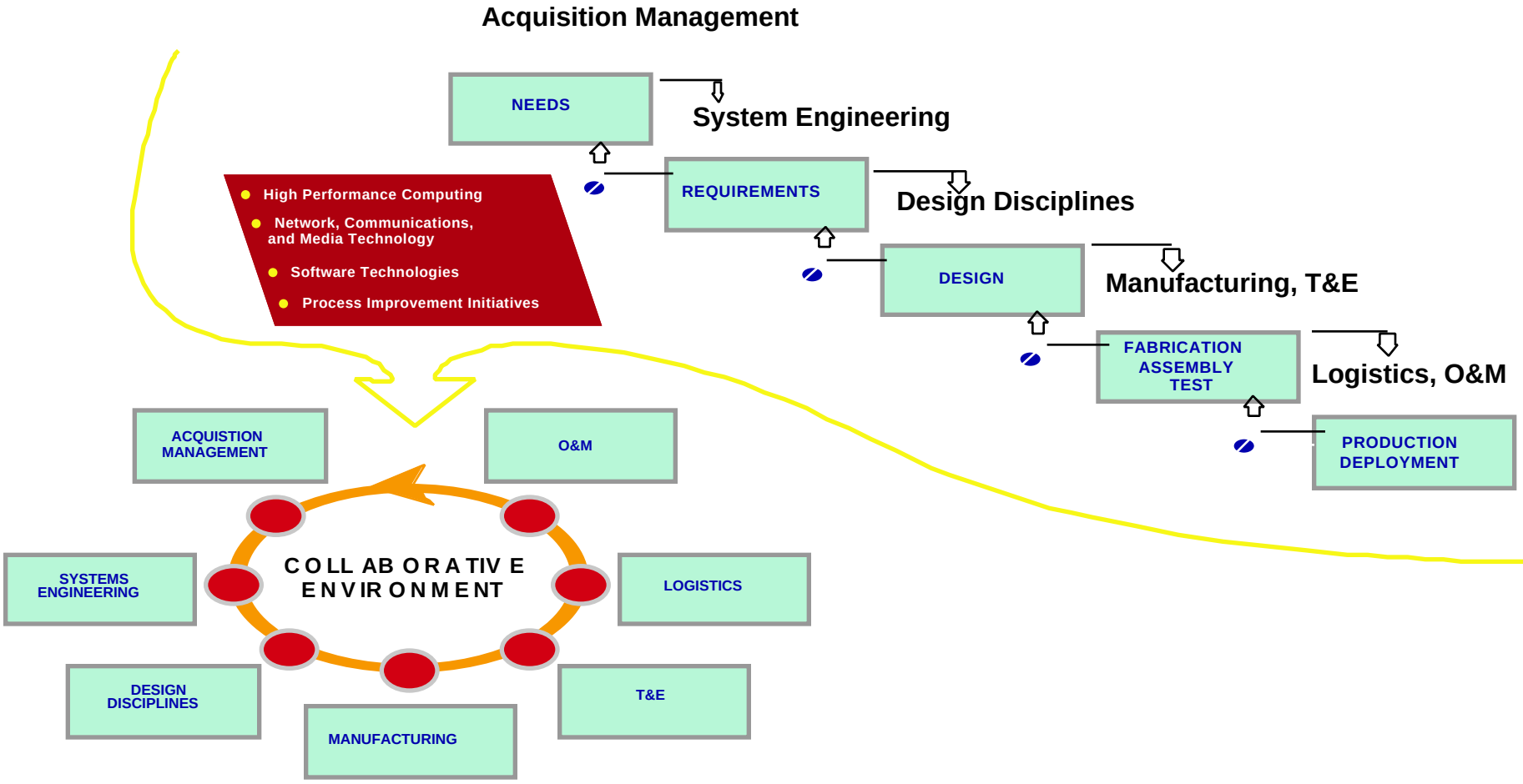


Detailed Smart Product Model

Virtual Life-Cycle for Acquisition of Complex Products

Simulation-Based Design

Acquisition Paradigm Change



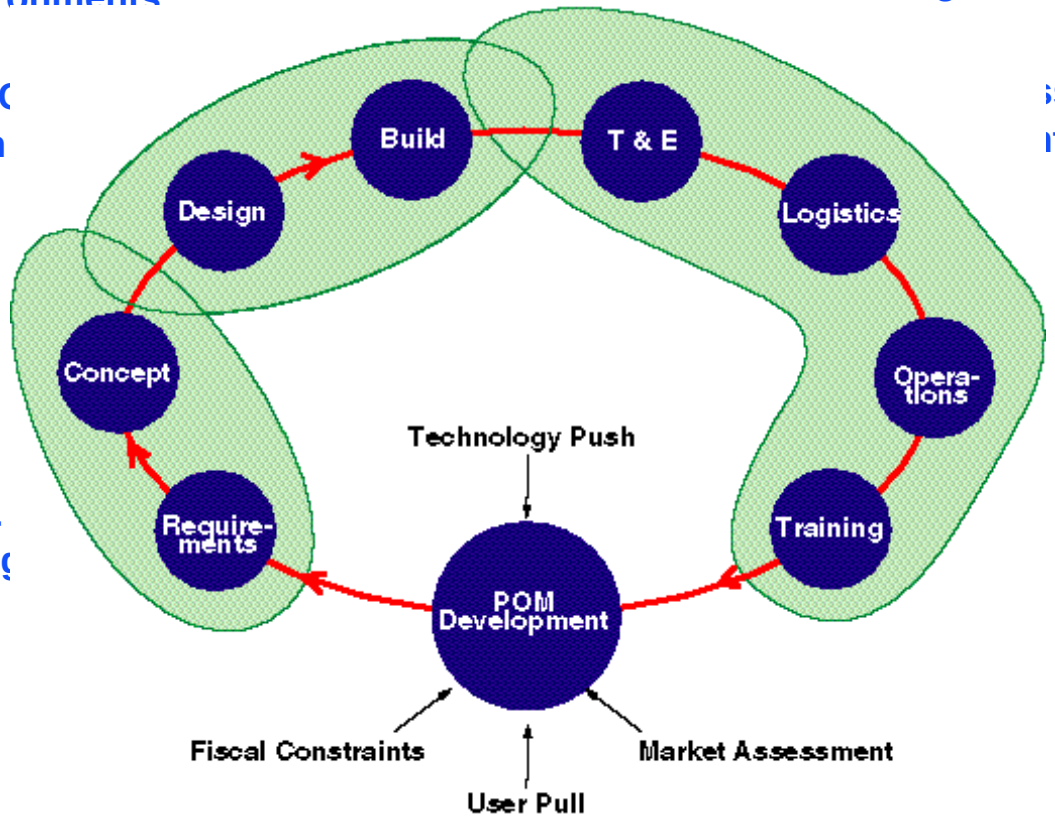
ENABLES SBA

Simulation-Based Design

- Product Model Definition
- Multi-Disciplinary Analysis
- Design Environments
- Simulation
- Solid Model C
- Visualization

- Design for Manufacturability
- Design for Maintainability
- Virtual Manufacturing

- set Visibility
- nterprise Infrastructure



- Performance-Based Costing

- Mission Effectiveness
- Early/Continuous Training
- Design for User/Operator
- Train to Maintain

- Mission/Concept of Operations
- Procurement Strategy
- Other Life Cycle Considerations
- Process Issues

Programmatic Strategy

- Infrastructure
- Engineering Experiments
- User Involvement
- Transition

Simulation-Based Design

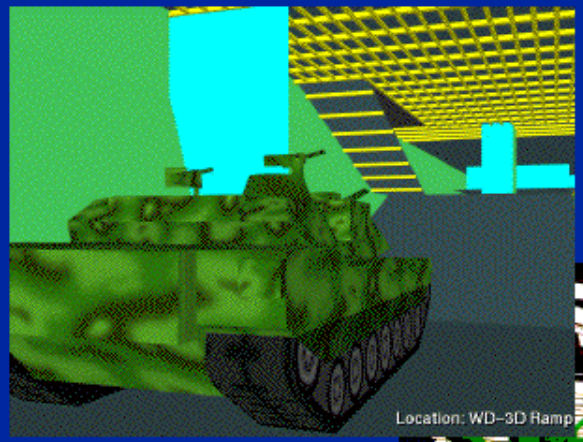
Critical Infrastructure Technologies

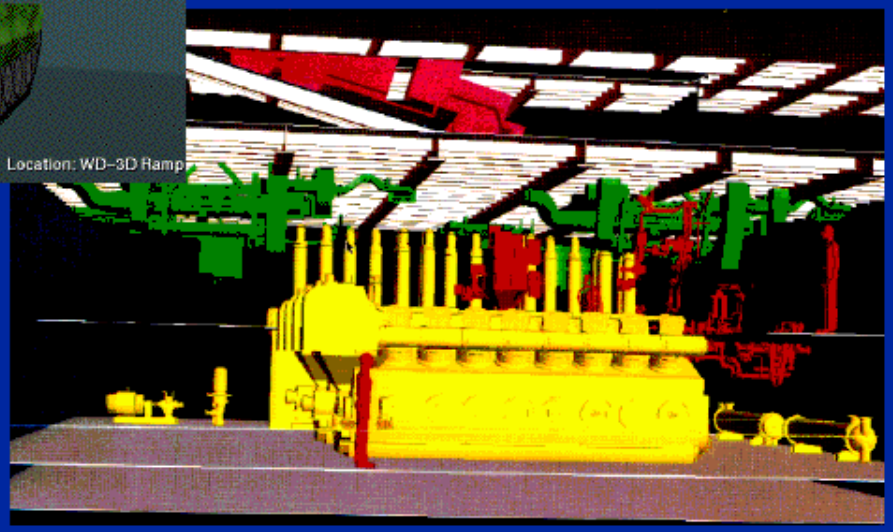
- Smart Product Model (SPM)
- Multi-Disciplinary Optimization (MDO) and Multi-Disciplinary Analysis (MDA)
- Communications and Collaboration
- Virtual Design Environment

Simulation-Based Design

Engineering Experiments

Simulation-Based Design





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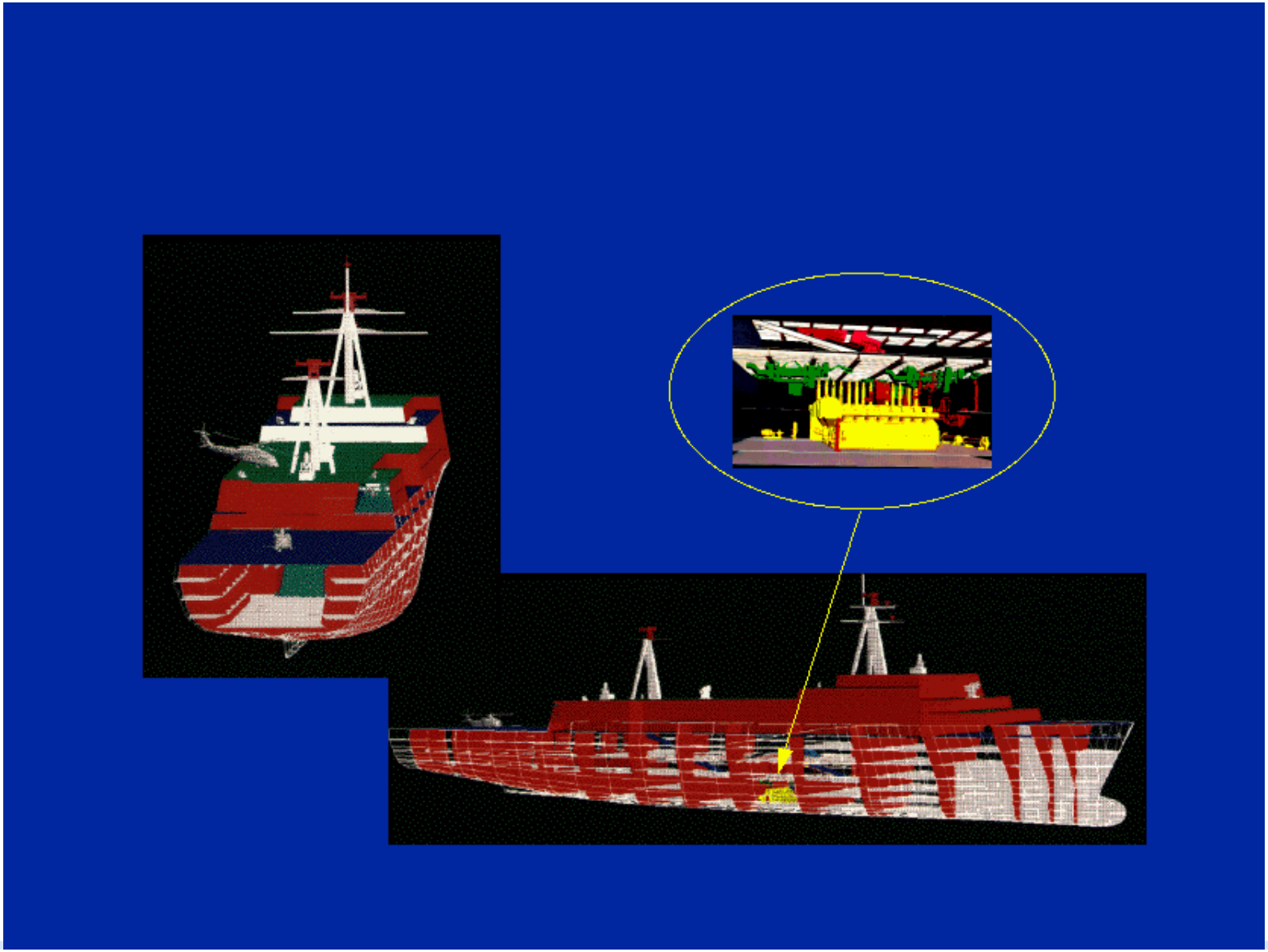
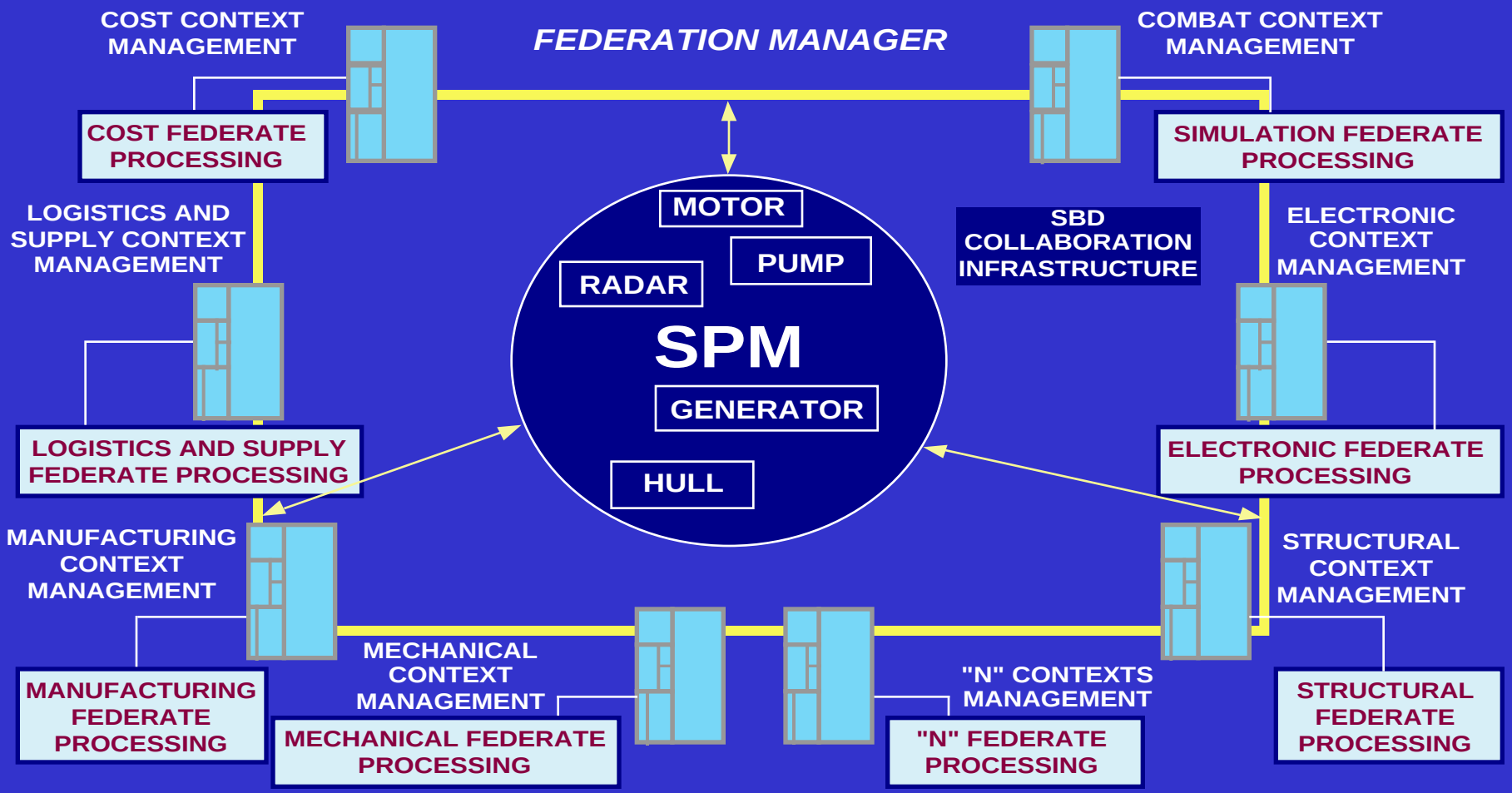


Simulation-Based Design

SBD Architecture Overview



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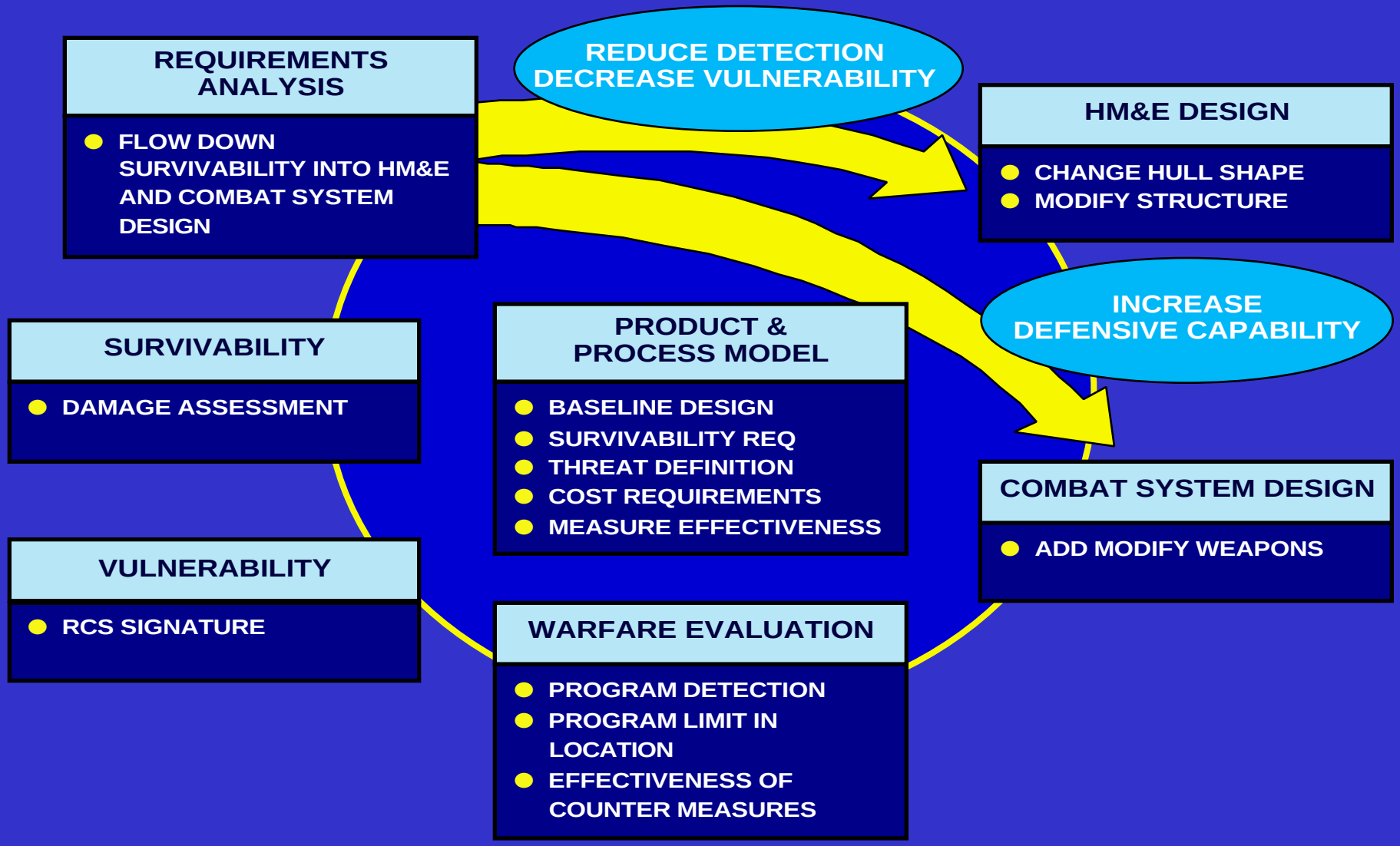

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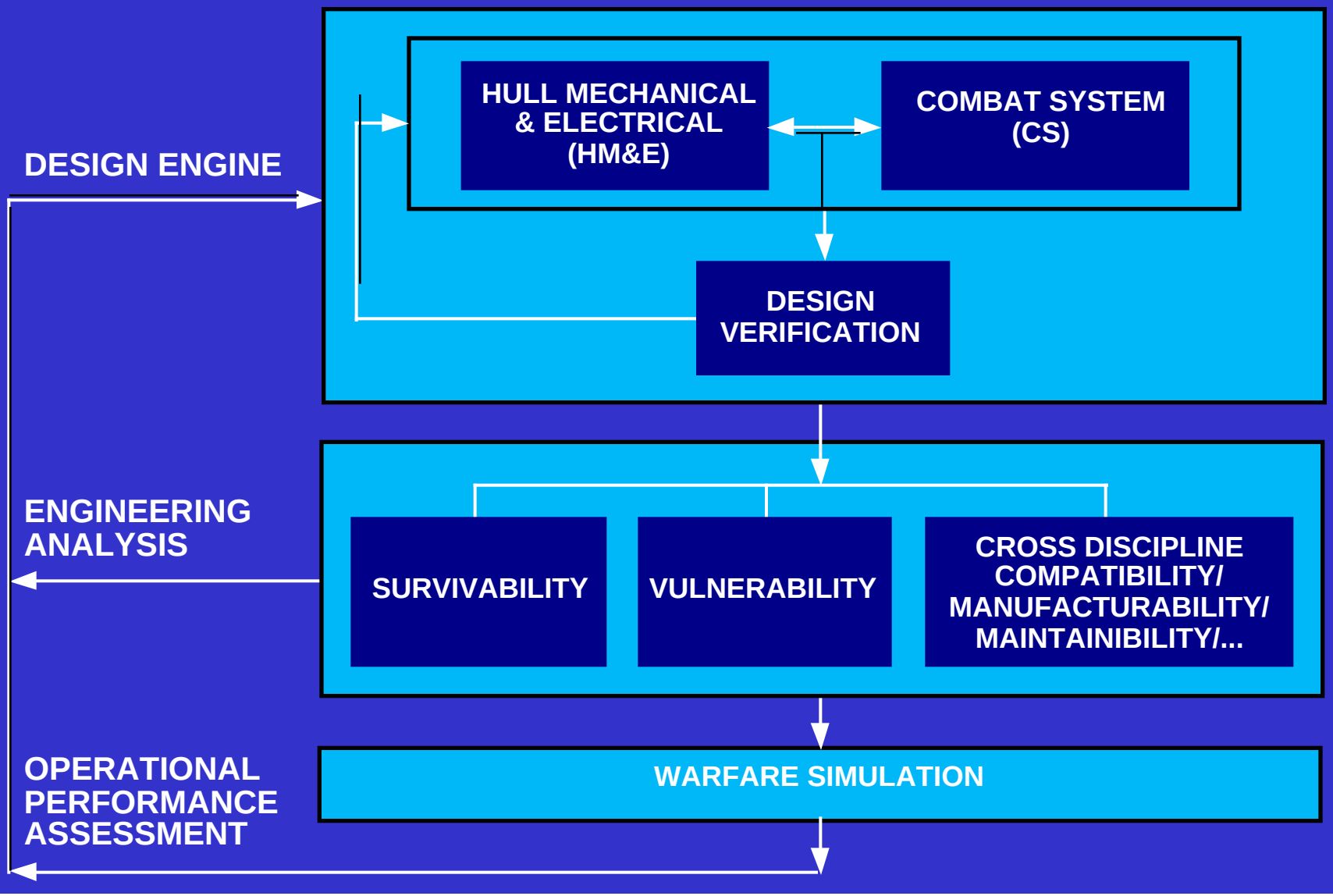

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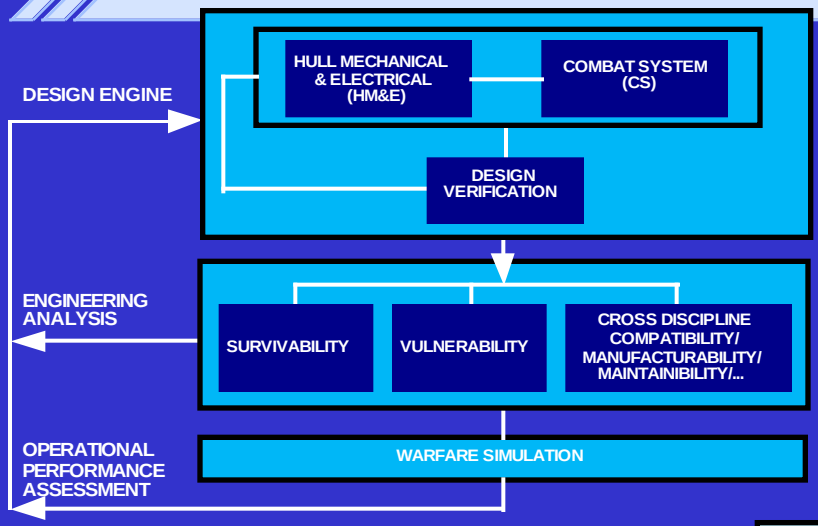

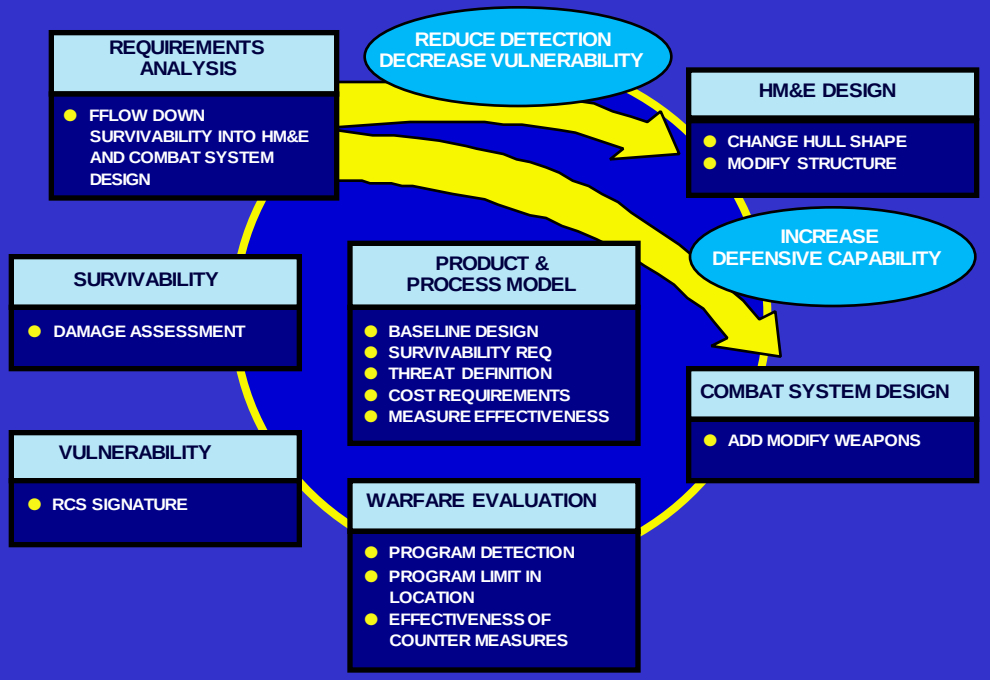

Simulation-Based Design

Engineering Proto-Federation – Prototype Demonstration

Distributed

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Virtual Ship
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Synthetic
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Ship

- Virtual Ship Product Model
- Comprehensive Object Description
- Design Variation and Reply Resulting from Threat Interface Collaborative Design Environment Dense
- Product Life Cycle Detail and Demo
- Leads to Elec. System VP w/ Synthetic Environment

- Provides Scalable Engineering Functionality
- Multiple Demos Embedded
  - Design
  - Construction
  - Training
  - Manufacturing
- Ship Radar Computed Remotely

Missile

- Simulate or Stimulate
- 6DOF

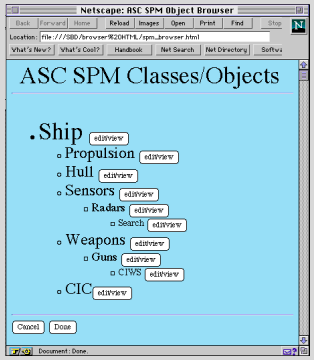
Aircraft: IADS, T&E-EW, JMASS

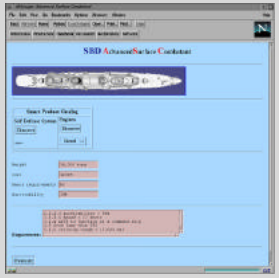
- Jammer Interface w/ Aircraft in the Loop

Simulation-Based Design
ASC OBJECTIVES

TTO Tactical Technology Office

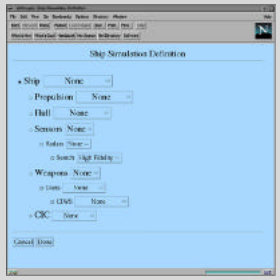
DESIGN BROWSING



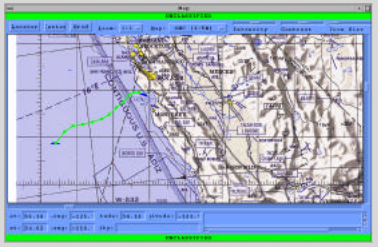


CATALOG COMPONENT SELECTION

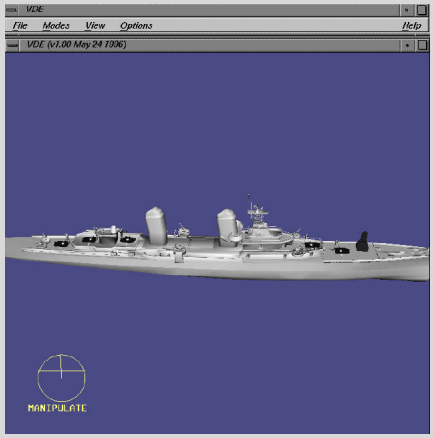
SIMULATION DEFINITION

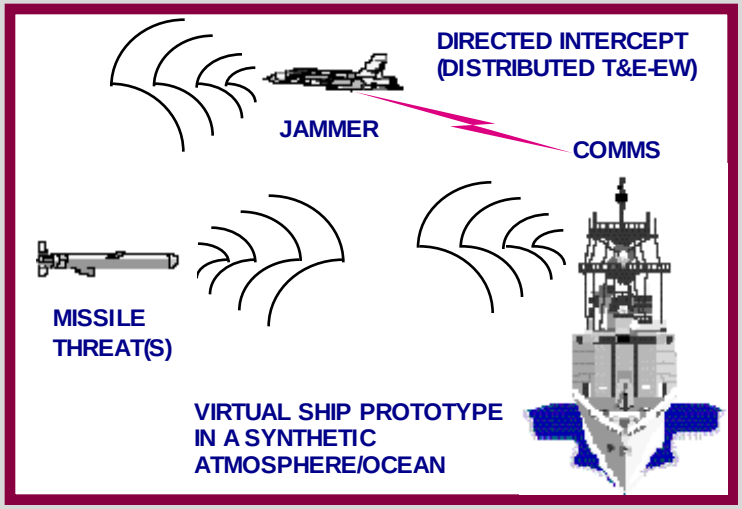


SCENARIO DEFINITION

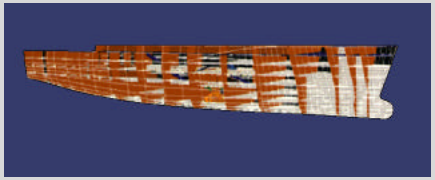


WEAPONS LAYOUT





HULL REDESIGN



SIMULATION EXECUTION

- INTEGRATION AND COLLABORATION IN A VIRTUAL ENTERPRISE
- SEAMLESS INTEGRATION OF DATA AND TOOLS
- MULTIDISCIPLINARY ANALYSIS AND EVALUATION OF COMPLEX SYSTEMS

Simulation-Based Design

DARPA

TTO
Tactical Technology Office

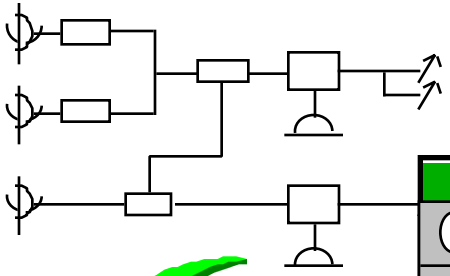
"Horizontal" System-Level Design

Rapidly define, configure and evaluate functionality

Requirements Prototyping

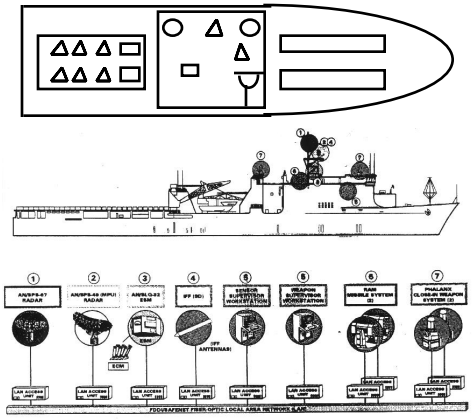
- Mission Statement
- Mission Roles/Functions
- ECS Functional Allocations
- Mission Scenarios & MOEs
- Notional Ship & ECS Simulation

System Architecture Definition

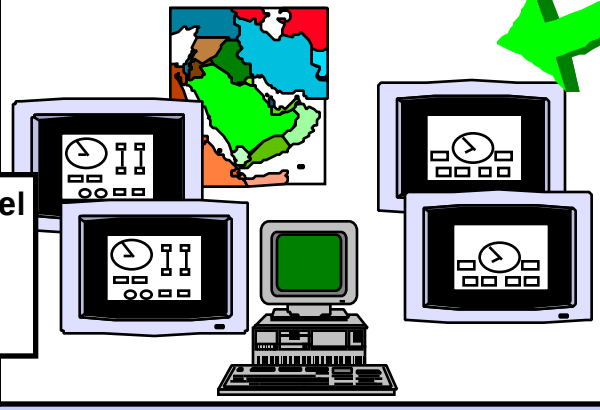


Configure Architecture
Drag & Drop ECS Components
Electronic Catalog

Physical Layout Definition



Functional Simulation & Visualization



Functional Sims at Console Level
Stand-Alone or Full Wargame
CO & TAO Tour Virtual CIC
Situational Awareness

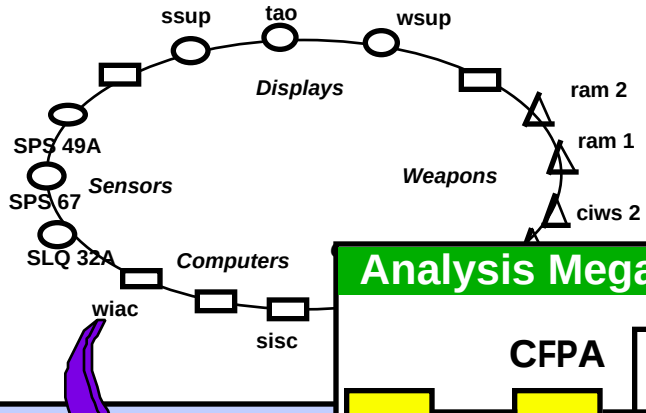
Detailed Layout
Immersive Environment
Connectivity from Architecture

Simulation-Based Design

"Vertical" Component Design

Go as "deep" into design as needed

Network Simulation



Catalog of Reusable Component Designs with Associated Analyses

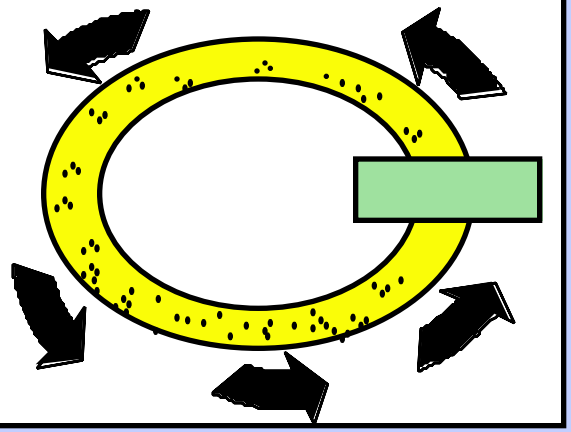
Network Sims
Perfromance Sims
Physics-Based Sims

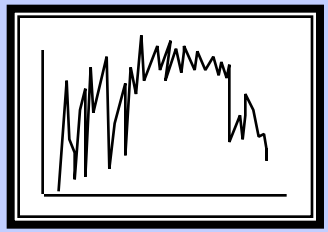
Analysis Megaprogram

CFPA

Visual Implementation of Mega-Programming for Optimizing Design

Physics-Based Simulation





User Involvement

- Aeroelastic Wing - Advanced Structural Design
- Virtual Satellite - Scaled Manufacturing
- Electro-mechanical System
- Submarine Virtual Test & Evaluation - Synthetic Shock Environment

Simulation-Based Design

TTO Tactical Technology Office

SBD ARCHITECTURE

CAD
- INTERGRAPH
- IDEAS
- PRO-E
- CATIA
- CV-CADDS

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DISCIPLINE SPECIFIC ANALYSIS
- STRUCTURAL DYNAMICS
- HYDRODYNAMICS
- SPACE ENVIRONMENT
- THERMAL
- SURVIVABILITY

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USER APPLICATIONS

SPM SCHEMA (MODEL, CATALOGS)

SBD SERVICES
- FEDERATION MANAGER
- RUN TIME INFRASTRUCTURE
- 3D VISUALIZATION AND INTERACTION
- MULTI-DISCIPLINARY OPTIMIZATION
- WRAPPER TOOL KIT
- GUIs AND BROWSERS
- MEGA PROGRAMMING

MODEL CLASSES
- SYS
  - COMP.
- SHIP
  - HM&E
  - CIC
  - ECS
  - PROP.
  - .
  - .
  - .
- SPACECRAFT
  - STRUCTURE AND MECHANISMS
  - ELECTRICAL POWER
  - DATA PROCESSING
  - PROP.
  - .
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SBD COLLABORATIVE INFRASTRUCTURE

SBD STANDARDS
- CORBA
- HLA
- VRML
- HTML

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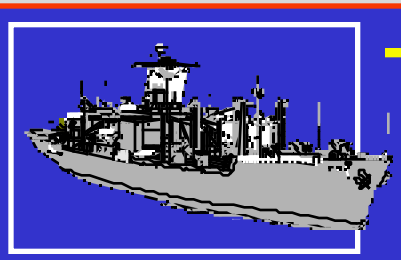
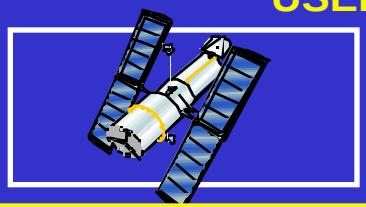


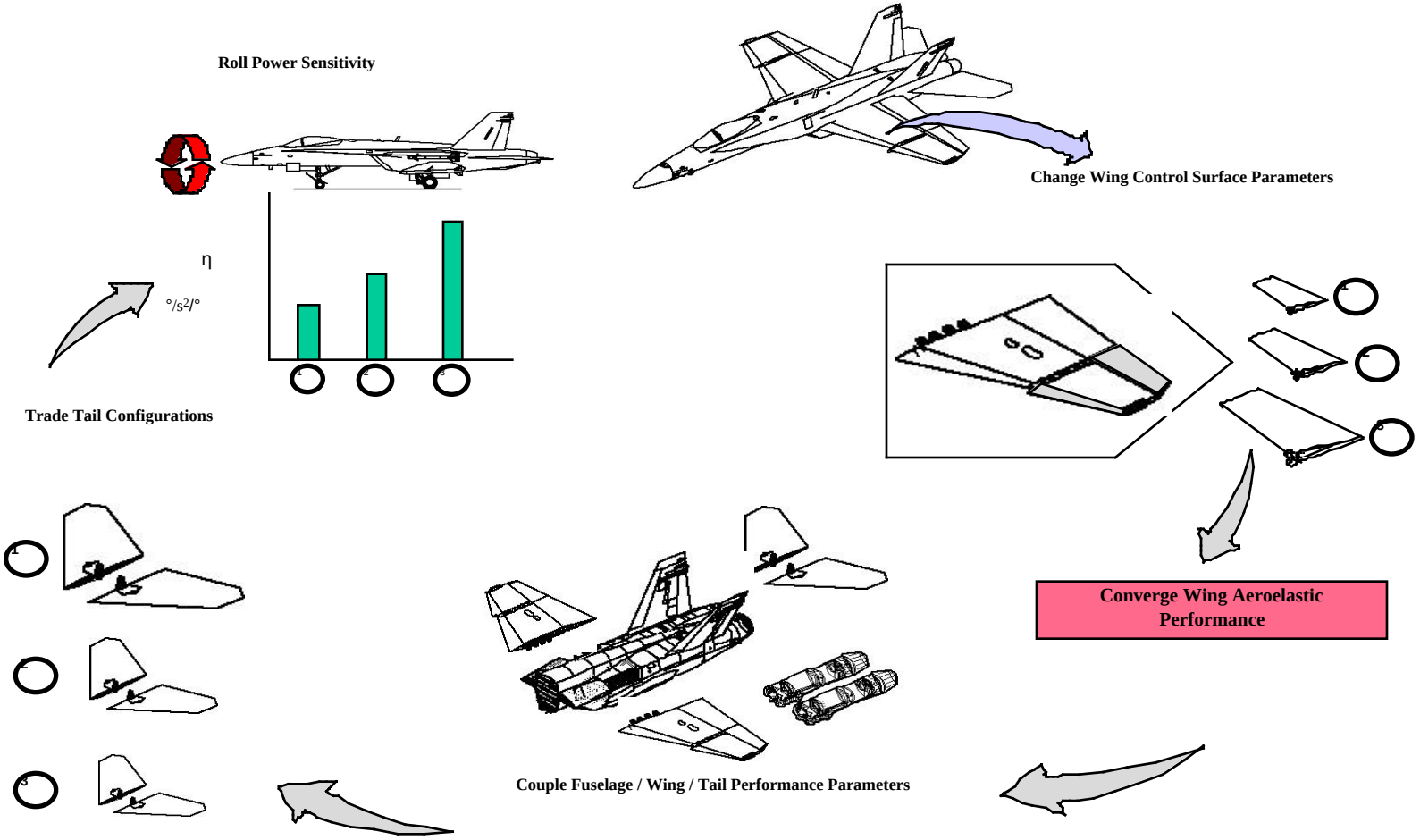


USER GUIs

GLUE FOR COLLABORATIVE ENTERPRISE

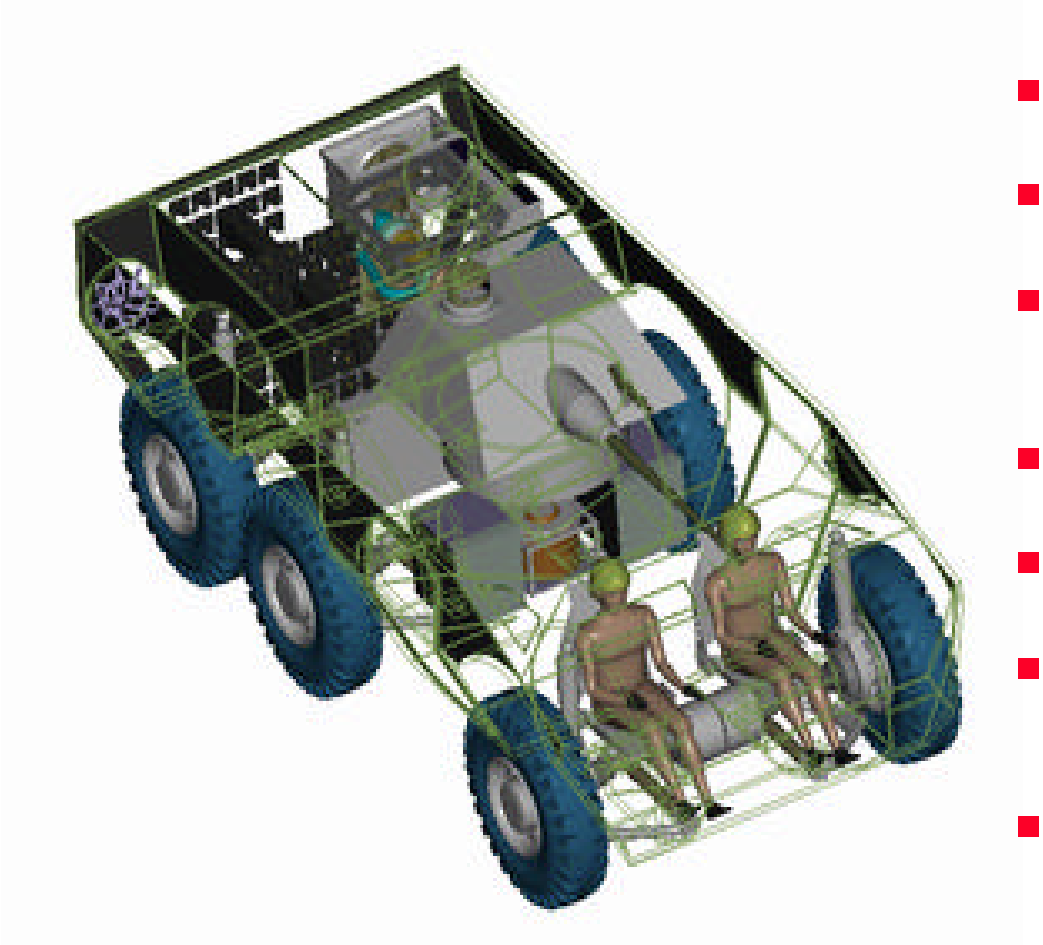
Simulation-Based Design

Aircraft SPM Practical Demonstration



Simulation-Based Design

Hybrid Electric Combat Vehicles



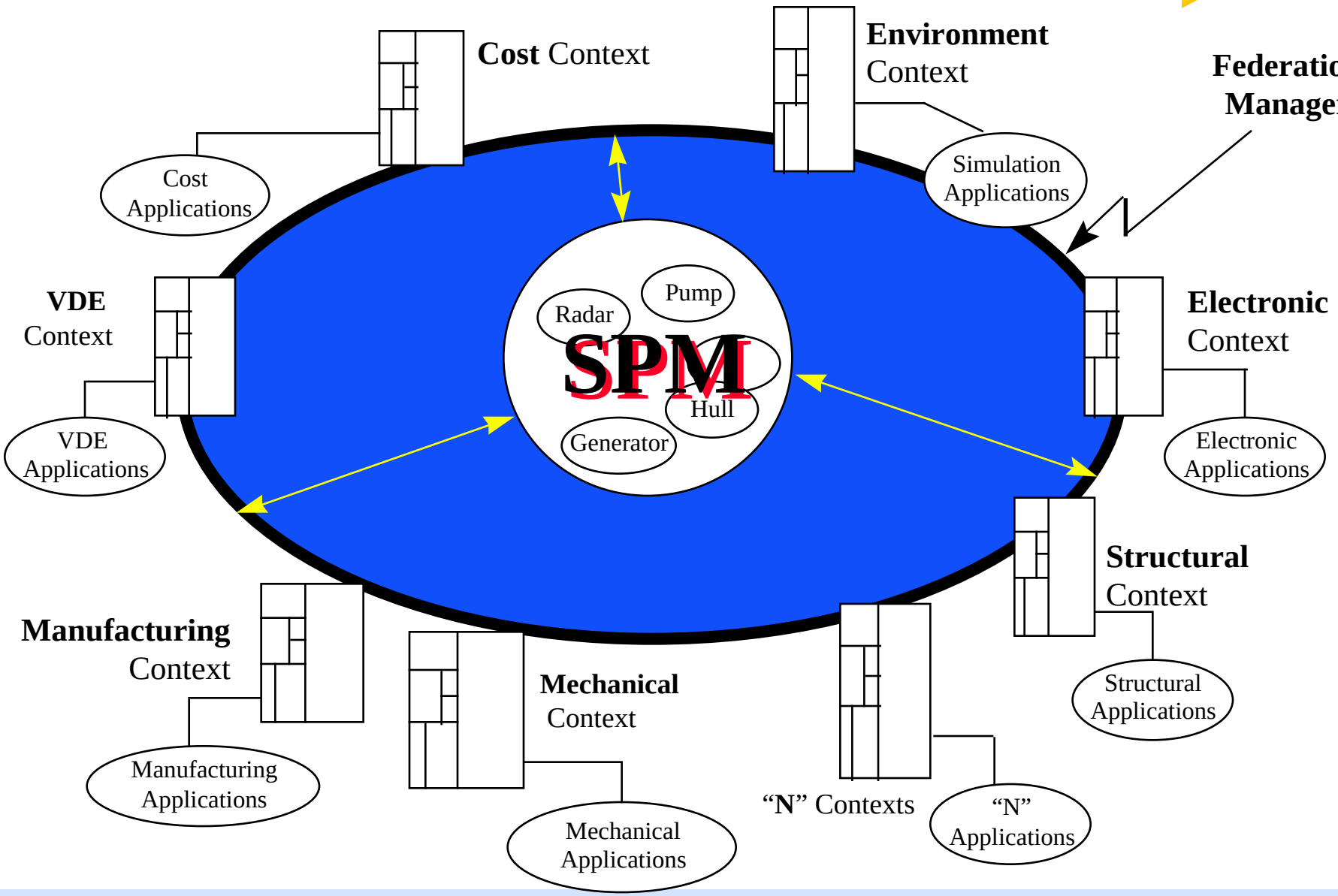
- Mission and Requirements
- Weight and Volume Control
- Power System Architecture and Load Management
- Thermal Management
- Power Quality/Stability
- Electromagnetic Compatibility and Grounding
- Fault Tolerance

Simulation-Based Design

TRANSITION STRATEGY

- SBD Is A Technology Component of ASN-RDA(ARO) Simulation Based Acquisition Program
- Close Coordination With User Community
  - Arsenal Ship - Concept Analyses
  - Navy Laboratories Are Team Members
  - Close Coordination With NAVSEA (03)
- Multi-Domain Applications to Stress System and Extend the Base of Users
  - Scaled Manufacturing for Spacecraft
  - Submarine Virtual Test and Evaluation
  - Electro-Mechanical Power Systems for Land Vehicles
  - Advance Structural Design for Aircraft
- Develop a Cross-Service Engineering Experiment

Simulation-Based Design



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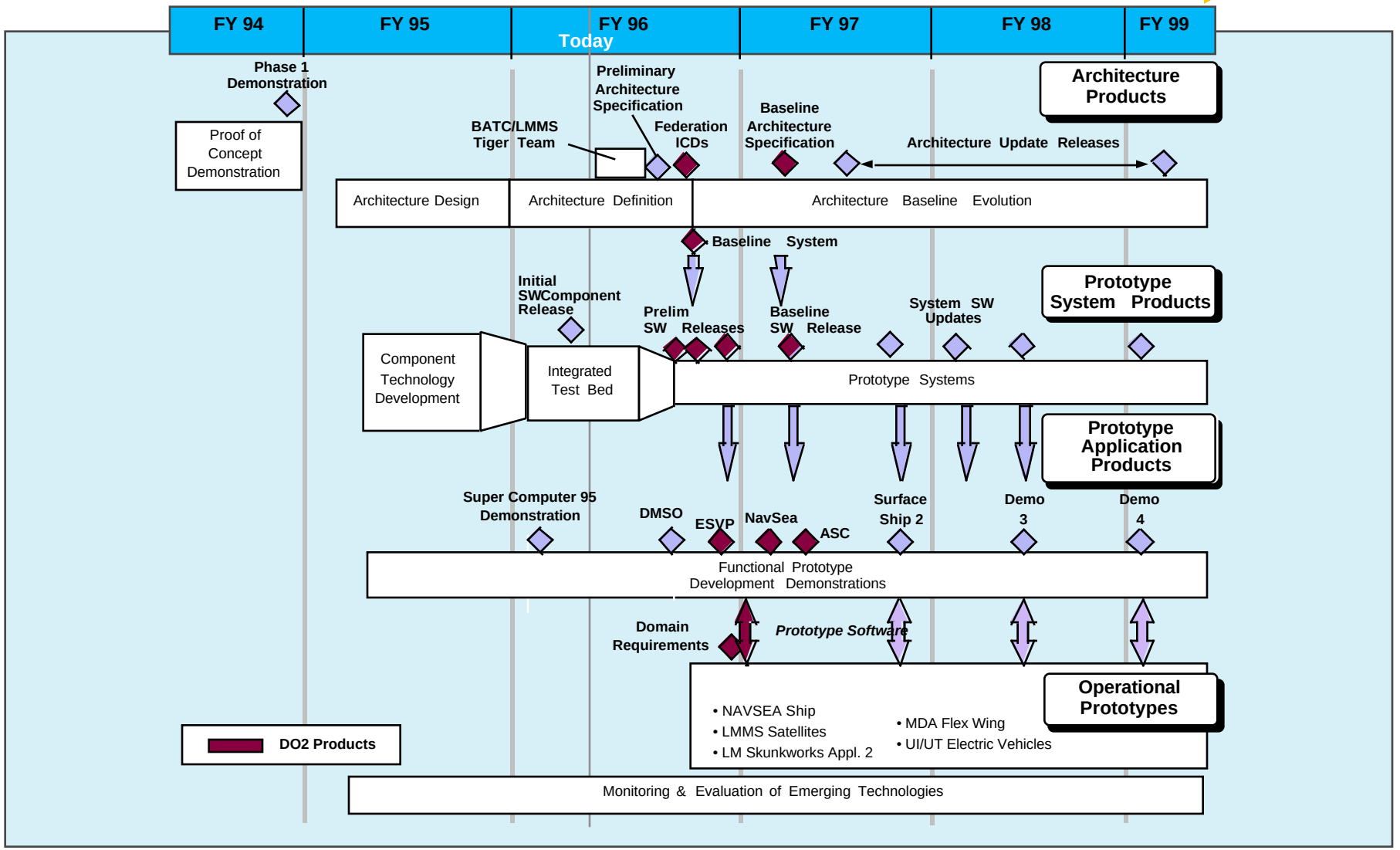
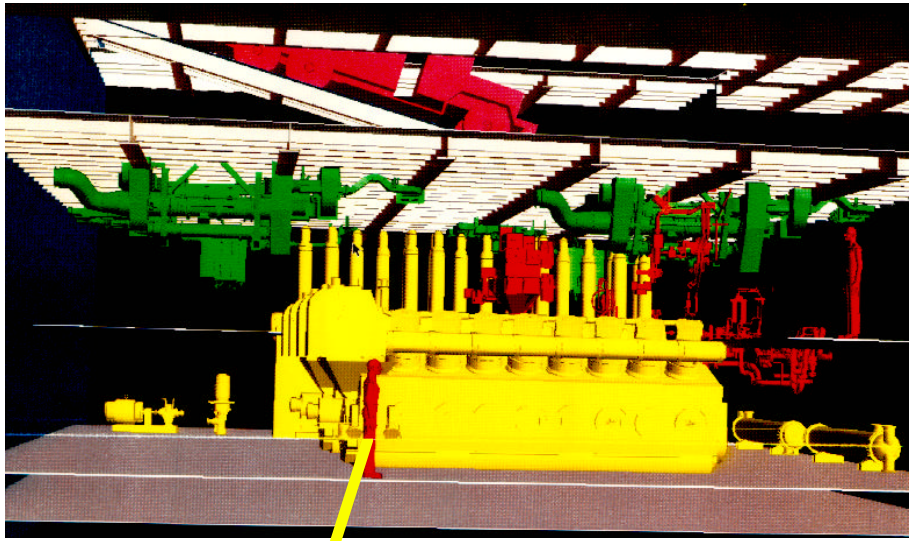


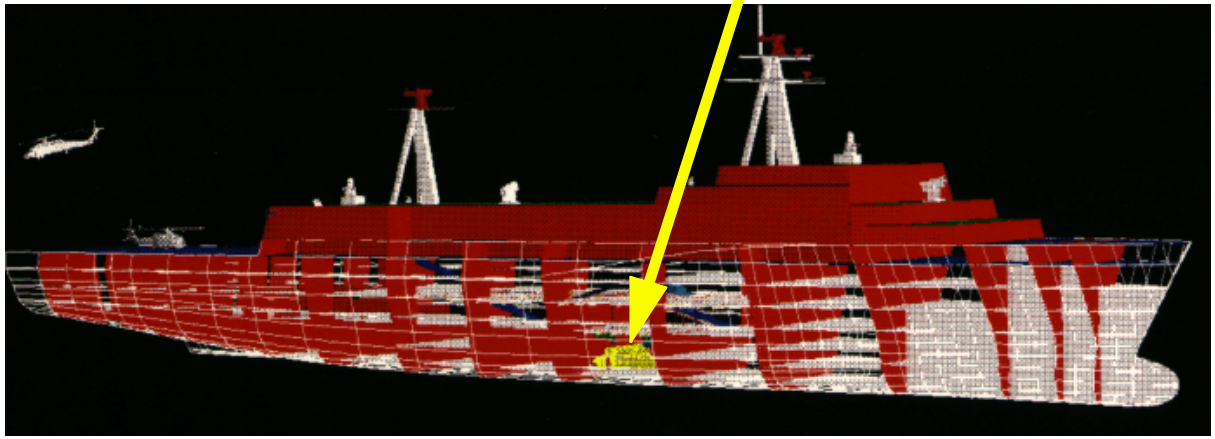
SBD Product Plan

Simulation-Based Design

Design and Enterprise/Integration

- **Smart Product Model Concept and Structure**
- **Smart Product Model Catalog**
  - **Text**
  - **Graphical**
- **Vendor Interface – ProductNet**
- **Smart Product Model Interface to the Virtual Design Environment**





Simulation-Based Design

Human Computer Interfaces

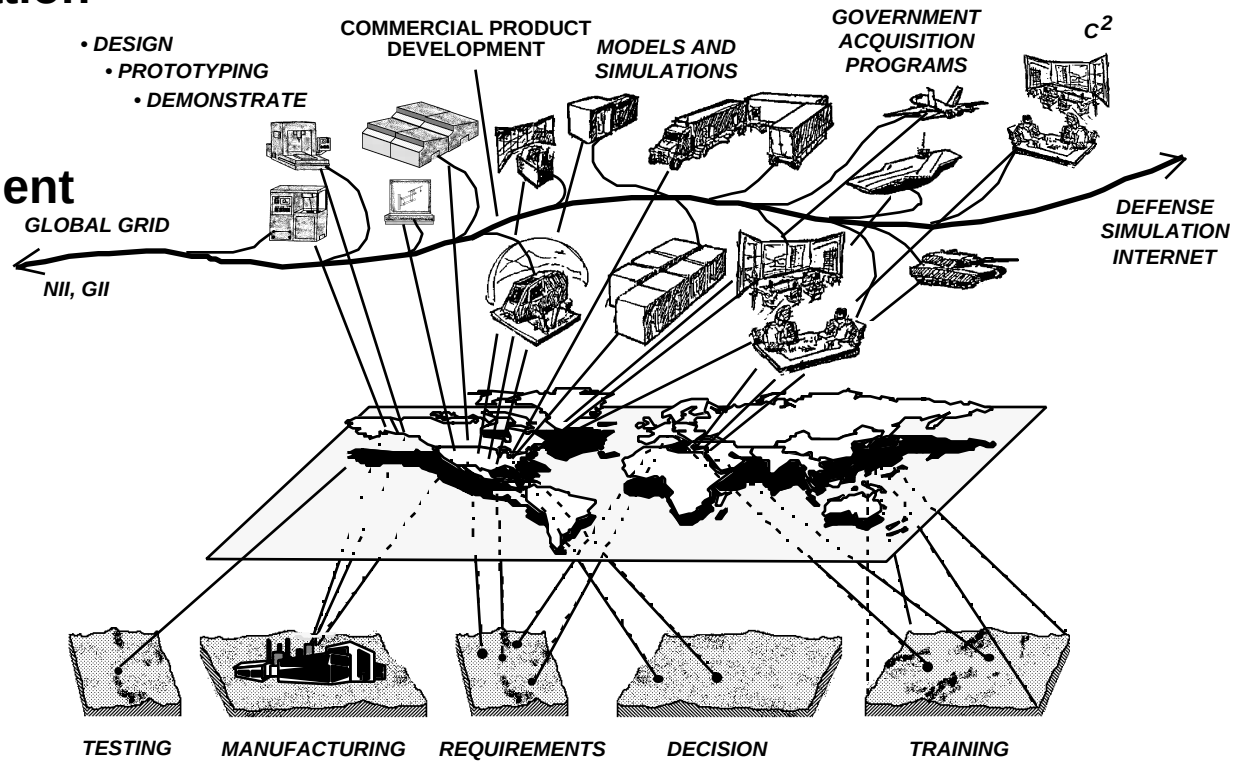
- **Multiple Immersion**
- **Space Mice/Head-mounted Displays/Flat Screens, etc.**
- **Pointers and Menus in the VDE**
- **Simultaneous Tasking of Multiple Computers**
- **Model Generation – Data Entry and Modification**

Augmented

Simulation-Based Design

Network and Communications

- **Remote Distributed Immersion**
- **Area Distribution of the Product Model**
- **Database Synchronization**
- **Distributed Interactive Simulation (DIS) in an Engineering Environment**
- **DIS Linked to a Smart Product Model**



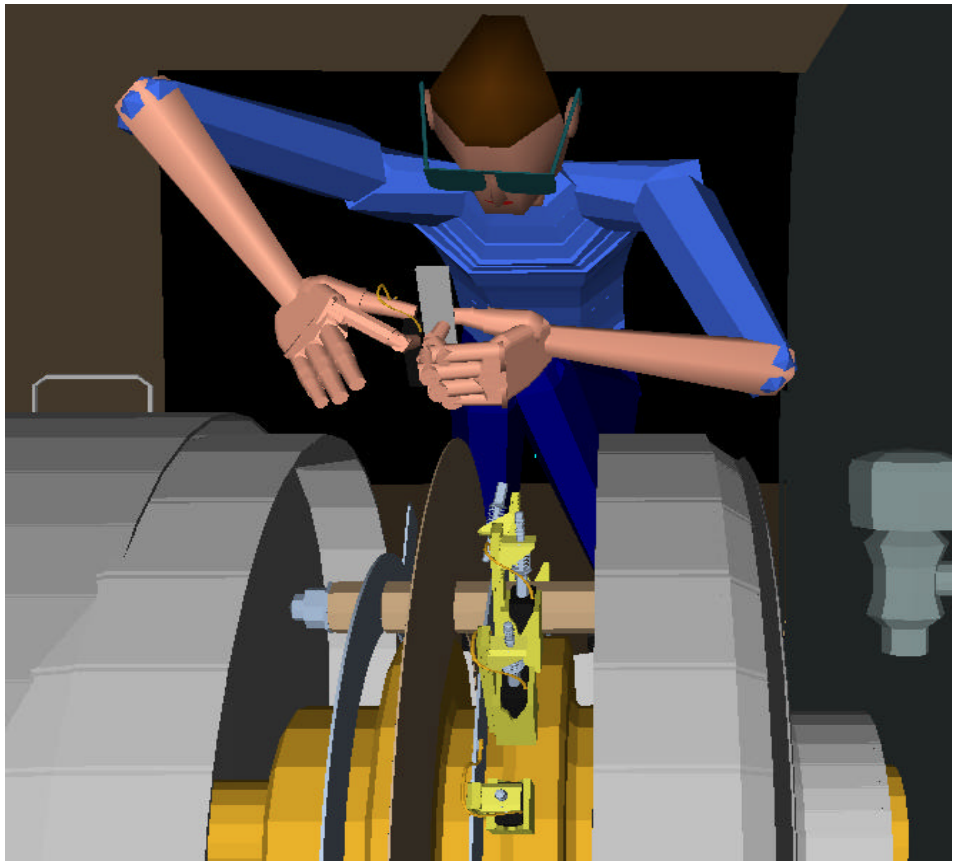
Simulation-Based Design

Maintenance Analysis

- Use of Anthropomorphics
- Maintenance Accessibility

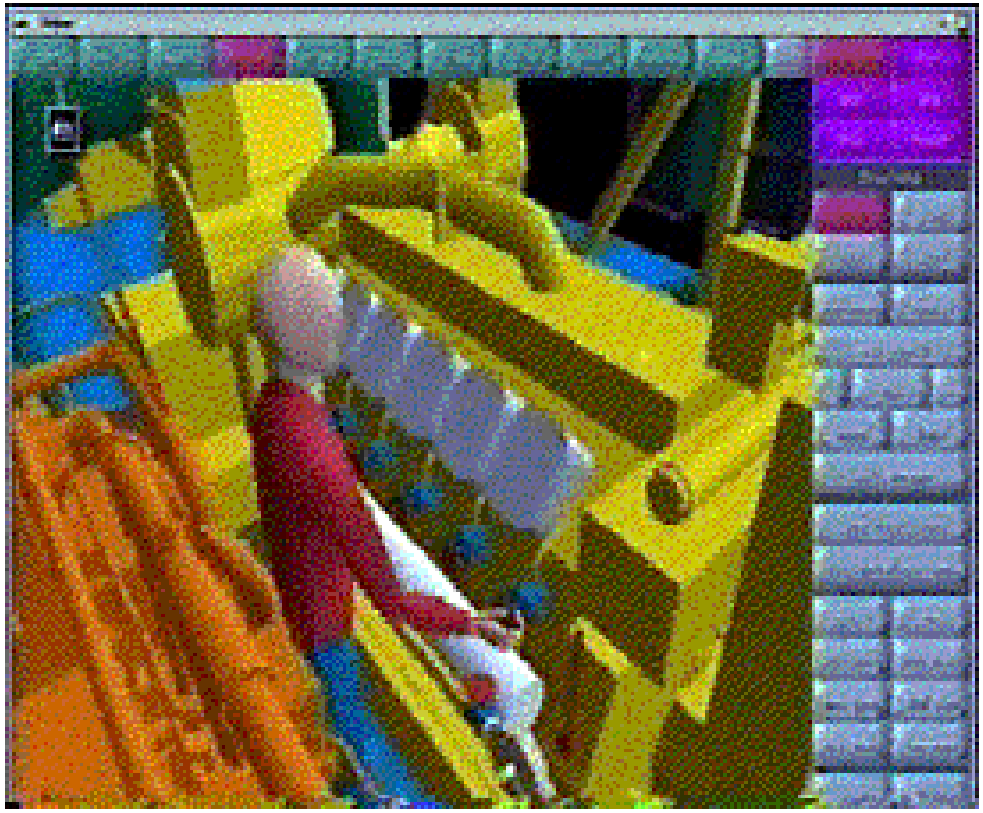
Time Motion Studies

- Derivation of Forces and Other Ergonomic Information



Simulation-Based Design

- Training Link to Early Design
- Complex Casualty Modeling in VDE
- Multiple Immersion
- Physical Interaction with the VDE
- Sensor-generated Information
  - — Characterization of the Environment
  - — Update to the Synthetic Environment

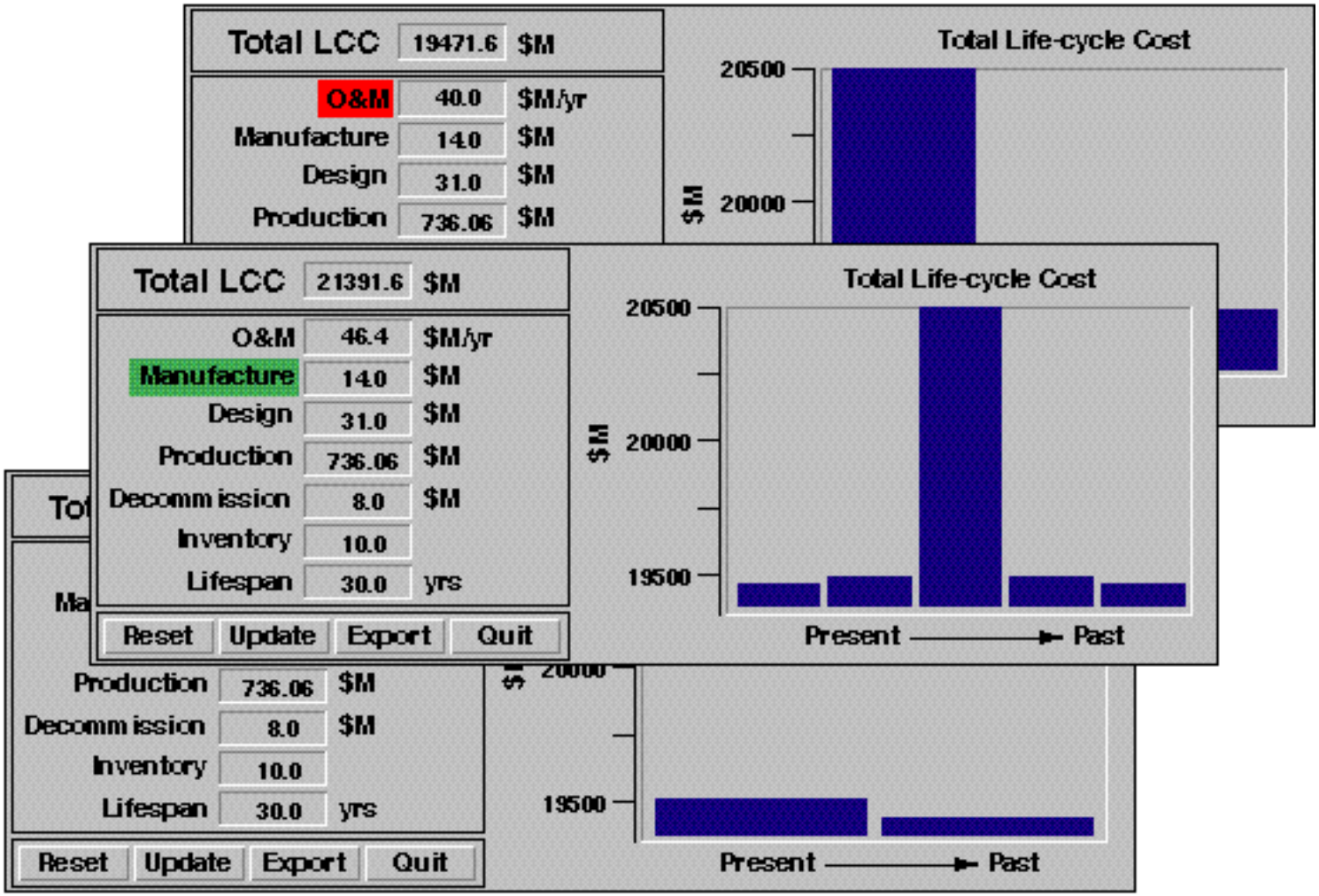


Simulation-Based Design

Manufacturing Analysis

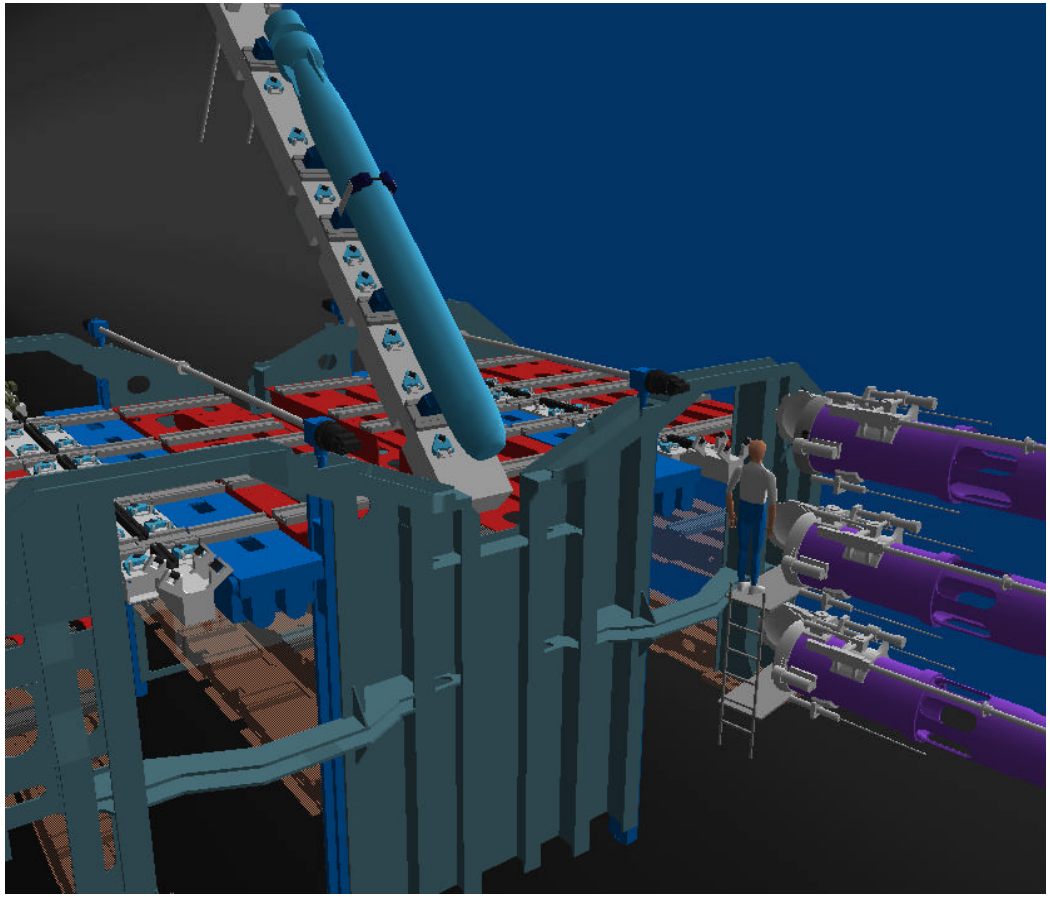
- Component Assembly
- Rapid Feedback Impact of Design Changes
  - Time and Cost
  - Manufacturing Tradeoffs
  - Business Decision Aid
- Impact of Alternate Manufacturing Facilities
- Agile Manufacturing Infrastructure
  - Product and Process Model Mutual Interrogation

Simulation-Based Design



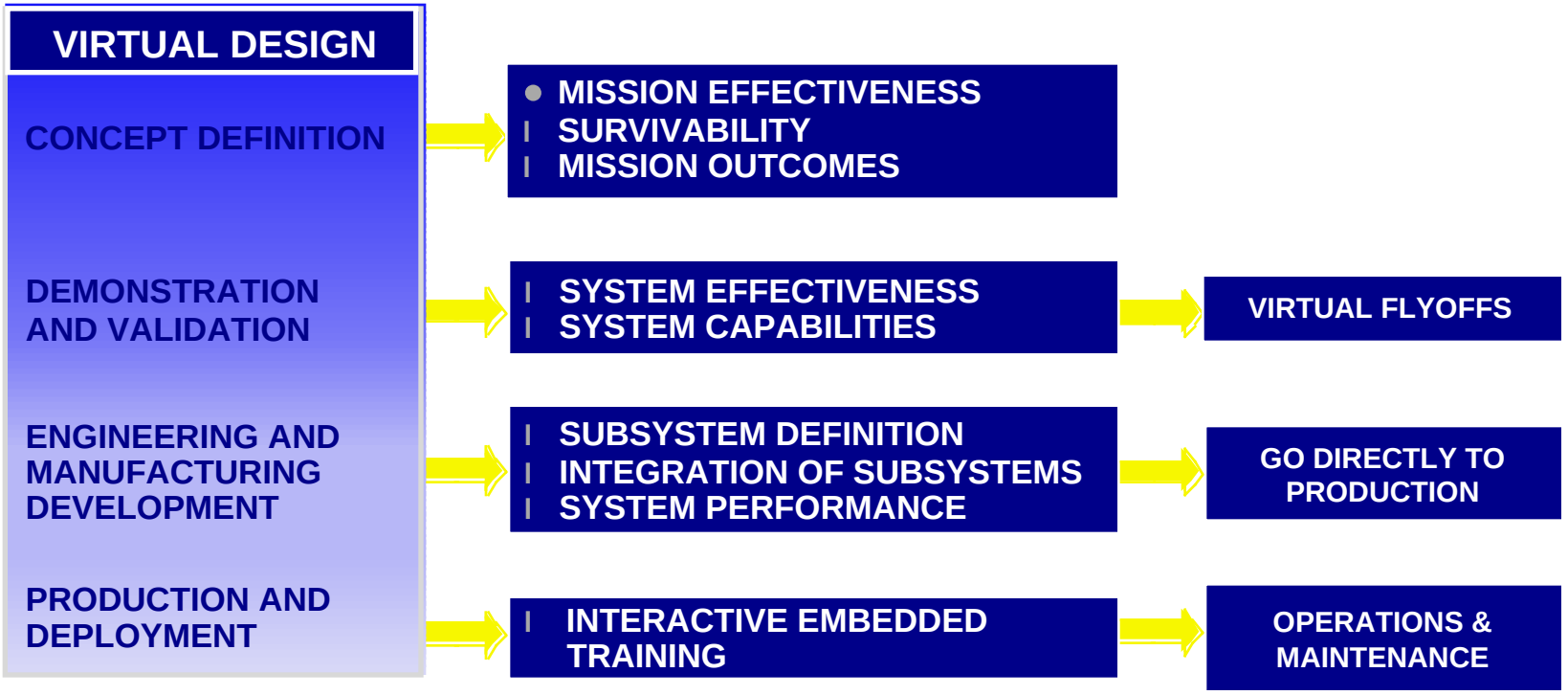
Simulation-Based Design

- Megaprogramming
- Rendering Techniques
  - Culling
  - Viewing Frustrum
  - Resolution



Simulation-Based Design

SBD's CHANGE ON ACQUISITION PROCESS



- **Compress the Lifecycle**
  - DO WHOLE LIFECYCLE IN PARALLEL AND PROCEED DIRECTLY TO MANUFACTURING
- **Update Key Assumptions Midstream**
  - PROVIDE TECHNICAL, COST, AND SCHEDULE RISKS FOR REAL-TIME IMPACT ASSESSMENT
- **Integrate Players**
  - SHARE MODELS AND SIMULATIONS BETWEEN PLAYERS IN FEDERATED SYSTEM

Simulation-Based Design